

SOME FACTORS IN THE SELECTION OF AN

ANAESTHETIC.

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ANAESTHETICS, a word of wide and interesting connotation to the Scientific mind - a subject which has been focussed alike by the Pharmacologist, the Physiologist and the Anaesthetist, as the object of considerable research and enquiry.

The Evolution of Medicine and Surgery during the past century has no more striking instance than the advances in the art of operative healing made possible by Anaesthetization. Humanity has been given a double boon, greater Therapy and increased light on disease in the living subject. The Layman's interest in this branch of Medical Knowledge concentrates on the Anaesthesia. The scientific mind speculates as to composition, indications for application, and to the facilities afforded for the abolition of normal responsiveness to stimuli.

What greater recognition of this Art and Knowledge can there be than the comparative tranquillity with which the unfortunate sufferer can now face surgical interference. Can one estimate the asset of Anaesthesia to the individual and to the World ? Can one estimate the alleviation of suffering to the countless numbers?

We are dealing with a medical science still in its adolescence, showing yearly signs of increasing stability and definition.

Professor Cushney in his "Foreword to Goodman Levy's recent manual

on 'Chloroform Anaesthesia'", lays stress on the combination of practical and laboratory experience and points out "how much the practice of Anaesthesia in Man is dependent on the principles of the basal sciences; how the same laws of physics hold in the ward and in the laboratory, and how necessary it is that the Anaesthetist should recognise their bearings on his problems". The Physicist can tell the volume of inspired air in shallow and deep respiration and of the gaseous interchange in the Alveoli. The Physiologist can tell the amount of Chloroform found in the Heart Post-mortem and the percentage vapour of Anaesthetic that may be considered safe or likely to produce Euthanasia in Animals. Neither however can tell how their findings are modified by those morbid processes for which Surgical Anaesthesia is demanded, nor can they tell how any individual will react to the combination of those morbid processes and the Anaesthetic.

Any attempt to elucidate all the Physical and Physiological problems met with would be beyond the scope of the writer, likewise no attempt has been made to enumerate the experimental output of the Physiological Laboratories, except in so far as they would appear to offer an explanation of those problems met with on the operating table and to which reference will be made later. The subject of Shock alone has an extensive literature of its own, much of it owing its origin to the problems encountered in the Great War of 1914 - 1918.

### SOME PHYSIOLOGICAL CONSIDERATIONS.

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The Anaesthetic substances are protoplasmic poisons and will kill the cells of the body if exhibited in sufficient concentration. With the exception of Nitrous Oxide, the Inhalation Anaesthetics most frequently used (Chloroform, Ether, Ethyl Chloride) have certain common properties. They are aliphatic derivatives; they are volatile, chemically inert, freely soluble in fats and oils and less soluble in water.

How they act, we do not really know. No less than nineteen different theories were collected in 1914 by Gwathmey of New York.<sup>(1)</sup> The Meyer-Overton theory of lipoid solubility was an attractive one, though containing certain fallacies. In 1916 Crile<sup>(2)</sup> advanced the theory that Anaesthetic action was due to an increase in the acidity of the blood - that animals "killed" by Anaesthetics could be revived by the use of Adrenalin which is alkaline. The infusion of alkalis, however, fails to overcome Anaesthesia. It is now supposed that the action of Anaesthetics on the cells is partly chemical and largely physical, "though it appears unlikely that any one physical property determines the action of these bodies, though the sum total of the physical properties may suffice to do so".<sup>(3)</sup>

The Toxicity of the Inhalation Anaesthetics lies in the concentration of the vapour, though there is no simple relation between the concentration of an Anaesthetic in the inspired air and the concentration in the blood. Paul Bert showed forty years ago that Dogs can inhale Chloroform vapour up to a

concentration of 0.5 per cent for many hours without ill effect. Waller and other Physiologists have laid it down that a two per cent Chloroform vapour was the limit of safety but laboratory experiments take no heed of those other factors, the morbid processes and the type and habits of the patients; e.g. The big muscular man and the chronic Alcoholic. While a two per cent Chloroform vapour may be, and usually is, sufficient to maintain an established Anaesthesia; Induction with such a percentage is frequently a failure. The practical application of this was well seen when the Vernon-Harcourt Inhaler was in more general use. Towards the end of induction the Anaesthetist was frequently seen to be warming the Chloroform Container by taking it in his hand thus frequently moving it to increase the percentage of vapour. The percentage readings claimed were two and two-and-a-half per cent, according to the position of the air - inlet stopper. Levy asserts that vapour up to 5 per cent can be obtained by oscillation of the Chloroform Bottle.<sup>(4)</sup> Levy further states that a vapour percentage of 3.5 is required not infrequently and a maximum of 4 per cent for exceptional individuals.<sup>(5)</sup>

Alcock has failed to produce Anaesthesia with a vapour of 3.5 per cent in a big muscular man.<sup>(6)</sup> Efforts have been made by Gibson and Laidlaw<sup>(7)</sup> to discover the amount of Chloroform present in the Blood after a fatal dose by estimating the amount of Chloroform found in the Heart after death. These observers

reaffirmed that Chloroform is largely carried by the red cells and found that Rabbits killed by Chloroform showed an apparent increase in the Chloroform content of the clot after two days under cold storage conditions. The explanation lay in the post-mortem loss of fluid and subsequent condensation of the clot. Their conclusions were negative, i.e. that the amount of Chloroform found in the Heart post-mortem was no indication of the amount which existed in the circulating blood at the time of death.

Very much larger percentages of Ether, than of Chloroform must be inhaled to produce Anaesthesia, percentages which, if presented at once will immediately cause catching of the breath and general respiratory irritation. It is bad practice and unreasonable to pour one or two drachms of Ether on to a thick gauze mask, lay it on the patient's face and expect him to respire normally. The point seems a laboured one but the writer has observed it on more than one occasion. The concentration of vapour depends largely on the fabric used and the fit of the mask to the face.

With Ether the Perhalation method is generally referred to - i.e. that method by which there is no air space between the edges of the mask and the face and the respired air passes almost wholly through the fabric employed to retain the Anaesthetic. Such a method gives a higher concentration of the Anaesthetic vapour and the more commonly used methods of Chloroform Inhalation did not purposely fulfil the idea of perhalation. <sup>18/</sup>Levy is of the opinion that the perhalation method is also preferable in

Chloroform Anaesthesia as being more amenable to regulation of the strength of vapour, using the area moistened by the drops of Chloroform at regular intervals, as a rough guide.

Blomfield suggests a drop for every inspiration for the first two minutes and this rate may be accepted as a safe rule for teaching purposes.<sup>(9)</sup> With increasing experience it can be modified to meet the expected requirements of the case.

The Vapour percentage is also largely modified by the temperature at which the Anaesthetic is presented. Pembrey and Shipway<sup>(10)</sup> found that with open Ether the temperature inside the mask varied from  $48.2^{\circ}$  to  $78.8^{\circ}$  F. Using warmed Ether vapour pumped under the mask from a Shipway's Apparatus the temperature was about  $90^{\circ}$  F. (The comparison, however, suffers from the fact that in the latter method, Perhalation through the mask is not in evidence as the source of vapour). They were further of opinion that in the Anaesthetized patient warmth increased the respiratory activity and stimulated the Heart. Considerable doubt has been thrown on the utility of efforts to warm the vapour, nevertheless the clinical observation holds good that there is less respiratory irritation with an artificially warmed vapour or with that type of inhaler where the Ether-carrying fabric is at some distance from the respiratory apertures, i.e. there is a larger and deeper dead space than under an ordinary open mask. In this type the expired air provides the necessary warmth. The inhaler should not be of the semiclosed cone type but of an equal diameter throughout. The opponents of warmed vapour claim that whatever method is used, the vapour will be at body temperature when it reaches the Pulmonary Alveoli.



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Clark states that a concentrated Ether vapour, which at 95°F. is respirable, at 45°F. is quite irrespirable by a conscious patient and will produce marked Bronchial irritation in an unconscious patient. Many experiments on the value of warming the Anaesthetic vapour were conducted by Gwathmey.<sup>(12)</sup> Using Chloroform vapour at room temperature the average time to kill sixteen animals was 6.57 minutes. Using warmed vapour the average time to kill seventeen animals was 20.35 Minutes. Similar results were obtained with Nitrous Oxide and Oxygen and passing the vapour through a vessel packed in ice, it took four minutes less to kill the animals than at normal temperature and thirteen minutes less than with warmed vapours. Gwathmey's conclusions cannot be accepted "en bloc" as no method of measuring equal percentages of vapour was used for the experiments; Goodman Levy<sup>(13)</sup> describes them as valueless though he admits that a heart overdosed with a Chloroform-Oxygen atmosphere will probably beat longer than when a Chloroform-Air atmosphere is employed.

As a result of these experiments Gwathmey, somewhat rashly, claimed that Chloroform with Oxygen is safer than any of the other Anaesthetics with air.<sup>(14)</sup> Goodman Levy maintains that Oxygen should be reserved for emergency - for deficient respiratory movements or obstruction to respiration and deprecates the tendency to its routine use as tending to cloak faulty methods of administration. The question of emergency and Oxygen apart it is generally admitted that Chloroform has a relative toxicity 6 - 10 times greater than Ether.<sup>(15)</sup> Cushney states that in the Laboratory Chloroform is 25-30 times as poisonous as Ether to the Mammalian Heart.



Without the use of Oxygen the relative toxicity of Chloroform and Ether has been studied by Fleming<sup>(16)</sup> on the Buccal Membrane of Frogs. Ciliary movements recover more quickly after Ether. In free swimming Protozoa which move by Cilia, the cessation of movement caused by Ether is often temporary, whereas that produced by Chloroform is generally permanent and is accompanied by dissolution of the organism with rupture to the cell membrane. The Effect of Anaesthetics on the body temperature is a fall varying from minimal amounts to  $1^{\circ}$  to  $2^{\circ}$  F. in prolonged operations. A fall of  $3.5^{\circ}$  F<sup>(17)</sup> has been observed during a very long Chloroform Anaesthesia. The fall of Temperature is greater, "the more complete the relaxation of the Muscular system"<sup>(18)</sup>. The exhibition of warmed vapour is said to lessen the drop in temperature.

ON THE BLOOD, the chief effect of Anaesthetics is chiefly one of deprivation of Oxygen-carrying-capacity of the red cells with an increase of  $C.O_2$  content. A temporary Lencocytosis is said to occur but with deep narcosis it is important to remember that some Haemolytic action has been described.

The Blood changes are more profound with Chloroform and the darkened colour of the blood in deep Chloroform Narcosis is obvious.

#### ACTION OF ANAESTHETICS ON THE CARDIO-VASCULAR SYSTEM.

It is probable that even with Chloroform a preliminary vasoconstrictor phase occurs. In full Chloroform Anaesthesia there is a well marked fall of Blood Pressure partly due to the action of the Anaesthetic "per se", and partly due to the

operative procedure. <sup>19</sup> Levy maintains that the Blood Pressure is better sustained if a dead level of Anaesthesia is maintained in the absence of course, of Operative Shock. Any reference to the paralytic action of Chloroform on the Heart and the more mildly depressant action of Ether suggests historically the Hyderabad Commissions and their President, the late Col. Lawrie, I.M.S., who never ceased to believe in their conclusions and stoutly maintained that Chloroform by the method of Syme was the safest Anaesthetic and that Chloroform fatalities were due to respiratory failure from the Medulla.

Shallow respiration probably depresses still further a heart poisoned with Chloroform and complete stoppage is probably produced by total Asphyxia. <sup>(20)</sup> A certain amount of Circulation goes on in the coronary and pulmonary vessels for quite an appreciable time after disappearance of the radial pulse. That Chloroform has a direct paralytic action on the Cardiac Muscle has been abundantly shown by Sir E. Schaefer, Sherrington, Waller, and many other Physiologists, and Heart Failure may occur with too light or too deep Anaesthesia, or after the administration of Adrenalin during Anaesthesia. <sup>(21)</sup> MacWilliams states that as long ago as 1887 Heart Failure under light Chloroform Anaesthesia was believed to be due to fibrillation in the Ventricles and Goodman Levy has conducted many experiments in proof of this. The majority of Chloroform deaths occur during induction and with light or intermittent Anaesthesia. It is under these conditions that Ventricular Fibrillation occurs. In pointing out the dangers of too light and uneven Chloroform Anaesthesia, <sup>(22)</sup> Levy has described the theory of overdose as "a most deplorable one for

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humanity". The same author and Roberts found that in Anaesthetized Cats and Rabbits, diminution and temporary arrest of respiration can be caused by Adrenalin in large doses and that this diminution or arrest is central in origin and due to vasoconstriction of the respiratory centre. The dangers of giving Adrenalin during Chloroform Anaesthesia are thus twofold. The action of Ether on the Heart is primarily stimulant and the Blood Pressure is raised. In full Surgical Anaesthesia the effect is feebly depressant and a slight fall in pressure occurs, which may become marked after severe or prolonged Surgical procedures. Ether has no direct paralytic action on the Heart like Chloroform and the fall in Blood Pressure is in no wise comparable to the steady fall occurring in Chloroform Anaesthesia.

#### RESPIRATORY EFFECTS.

An equal percentage vapour of Chloroform is much more irritating than Ether, but in practice this is not observed and the converse is true owing to the low percentage of Chloroform used. Up to two per cent Chloroform vapour is said to be non-irritating, though even two per cent may cause irritation in Smokers' Throats. After a short preliminary excitation the respiratory vigour is depressed by Chloroform and the effect is more pronounced, the deeper the Anaesthesia. The respiration in Anaesthesia is intimately bound with the question of Asphyxia or Anoxaemia - an increase in the  $C.O._2$  content or a deprivation of Oxygen.

Hyperpnoea is not always chemical in origin and due to changes in the Hydrogenion concentration in the Blood - to those changes

which it is suggested should be designated as "Acidaemia" or "Alkalaemia".

Hyperpnoea may also be nervous in origin - Consciousness may profoundly effect the Rhythm also the injection of Oil Globules or Starch grains into the Jugular Vein or Right Ventricle, so that they lodge in the Arterioles, of the Lungs will produce rapid respiration dependent on the integrity of the Vagus. <sup>(24)</sup>

Full Chloroform Anaesthesia diminishes the excitability of the respiratory centre to stimulation by  $C.O._2$ , though such stimulation cannot usually be observed in the open methods of administration. <sup>(25)</sup> Cushney has shown that the stimulating effect of  $C.O._2$  is lost in deep narcosis in animals. It is then said by Schmidt and Harper <sup>(26)</sup> to produce a purely inspiratory response, whereas in light narcosis the stimulating effect on expiration was very obvious. The same observers found that the stimulating effect of Ether on the respiration of Cats, persisted through the stage of Surgical Narcosis, but, that if the Ether was pushed, expiration failed and a series of purely inspiratory gasps occurred. The terminal effect is thus similar to Chloroform. Ether is not only a powerful stimulant, but unfortunately, an irritant to the respiratory passages. The application of too strong a vapour causes holding of the breath, coughing, straining, with Mucorrhoea and probably retching. Its effect on the respiratory Mucous Membrane is occasionally seen in Infusion Ether or Colonic Oil-Ether.

ETHYL CHLORIDE in high concentration if re-breathed is also irritating and the garlic odour is unpleasant at all times, but once conscious respiration starts in administration, there is none of the coughing and irritation of Ether.

### URINARY EFFECTS.

Many widely divergent results have been reported by different investigators. A fall in the urinary output is not surprising, considering the usual preparation for operation and the restriction of solid and fluid intake. The Pathological effects, i.e. the presence of Albumen and casts are more pronounced and more persistent after Chloroform. Fatty "Degeneration" may also be produced by this agent in common with Fatty "Degeneration" observed in other Viscera in cases of Acidosis, "Ketosis" or Post-Anaesthetic Toxaemia, which are less likely to occur after Ether, especially in septic conditions. The appalling post-operative mortality in acute sepsis in Children where Chloroform is used has been shown by Beesly.<sup>(27)</sup>

1. With Chloroform. In nineteen cases of Appendicitis of all types, fourteen died.
2. With Ether. In twenty-four cases of Appendicitis of all types, two died and one of these deaths was due to secondary Hemorrhage.

Eleven Autopsies all showed marked Fatty Degeneration of Liver, Kidneys and Heart. It has been later shown that the changes in the Liver are more in the nature of an excessive deposit of fat, rather than a true degeneration. Acidosis occurs also after Ether and after some short Anaesthetics for Tonsil and Adenoid Operations, but Acidosis of serious import is comparatively infrequent after Etherization. The symptoms are more likely to occur in ill-fed and semi-starved Children - whether by their parents or by too much preparation for operation.

### EFFECTS ON CENTRAL NERVOUS SYSTEM.

The primary action is that of excitation which may sometimes be almost described as exaltation, to be rapidly followed by confusion. A "descending" paralysis follows - the most highly developed cerebral functions being the first to disappear - the reason, the will and the ideational centres - Co-ordination is lost and movements are purposeless, speech is an inarticulate mumble or shout. The Sensory Nerves are effected and superficial reflexes are probably lost now. Of the special senses, Hearing is probably the last to go. Muscular relaxation soon follows, whilst the last to be effected are the Vital centres in the Medulla. The action of Anaesthetics is more central than peripheral and the Cord and Spinal Nerves are less effected than the Brain. The Ocular reflexes are those with which the Anaesthetist is chiefly concerned as a guide to the depth of Anaesthesia, but others not infrequently can only be abolished by a state of impending dissolution, e.g. stretching the Sphincter Ani or distending a Tuberculous Bladder.

In the writer's experience, the latter procedure is almost always productive of a vigorous reflex, chiefly respiratory even in a profound degree of Anaesthesia.

### ETHYL CHLORIDE.

Ethyl Chloride is stated to occupy a mortality rate between Chloroform and Ether and the Physiological effects are in the main those of Chloroform, the most notable and constant being a marked fall in the Blood Pressure. Muscular spasm, specially of the Masseters is not infrequent, hence the gag or prop is inserted before induction is commenced. Many of the reported



deaths were at one time (1903 - 1905) due to insufficient knowledge, and misuse of this useful Anaesthetic. If confined to suitable cases for brief Anaesthesia in the recumbent posture or as a means of rapid induction for Ether sequence, it is in many ways an ideal Anaesthetic. The writer has a personal experience of some 6,000 administrations and moments of anxiety have been almost conspicuous by their absence. He has never seen the pallor of primary syncope. Deaths have occurred in many Hospitals from Haemorrhage after operations for the removal of Tonsils and Adenoids, but these have not been connected with the Anaesthetic. Cases of Fatal Acidosis have also been reported.

#### ETHANESAL.

Wallis and Hewer found that many of the irritant and Anaesthetic effects of Ether were due to impurities. The former property being largely due to Mercaptans and the latter to the Admixture of Ketones. Working on these lines they evolved a purified Ether for which Hewer makes several claims - viz. diminished Toxicity and greater margin of safety - less irritation to respiratory passages and hence easier induction, less vomiting afterwards with less taste and smell of Ether. <sup>(28)</sup>

<sup>(29)</sup> Robinson has been unable to discover any of the alleged advantages over Ether and states that vomiting is more pronounced. The writer has not found this, though closed Gas-Ethanesal appears to produce the almost identical effects of Gas and Ether; with open methods Ethanesal is more easily respired, though induction is more difficult, i.e. the Anaesthetic effects are milder, the salivation and after effects are less pronounced.



NITROUS OXIDE, is pleasantly respirable without irritant effects. It is primarily stimulant causing a rise in the Blood Pressure which is largely modified by the amount of Oxygen delivered with it. Cyanosis and rigidity were the usual phenomena of Anaesthesia prior to the advent of Hewitt's two Bag Gas and Oxygen Apparatus and latterly, to the more complicated Inhalers of Gwathmey, Marshall, Boyle and others. The Gas appears to form a loose combination in the Blood and where administered without undue cyanosis would appear to have no deleterious effect on the Viscera. When given to animals the red blood cells are diminished 25% after thirty minutes Anaesthesia. The after effects of short administrations are usually conspicuous by their absence. The use of Gas and Oxygen in Major Surgery has been attended by a very considerable number of fatalities in America, also in Britain, where in many cases the Anaesthetic has been used in desperate cases. <sup>(30)</sup> Spilsbury reports a personal experience of Post-Mortem examinations in seventeen cases of Nitrous Oxide fatalities since 1913. Dreams under brief periods of Anaesthesia are common, and quite frequently very vivid and can be recollected when consciousness returns.

## THE CHOICE OF THE ANAESTHETIC.

Two main Factors are involved :- (1) The Patient and (2) The Operation.

A. The Patient :- Age, Sex, Type and Temperament, Physical Condition.

B. The Nature and Probable Duration of the Operation.

Both Factors will be considered simultaneously.

The Anaesthetic substance of universal use and application has yet to be discovered - most Anaesthetists have favourite routine methods but any known method is of necessity liable to modification to meet any of the above conditions. A third factor might well be mentioned, - the availability of an Anaesthetist.

The Practitioner calls in another Practitioner to "give a whiff". This can very frequently be taken to mean a "whiff of Chloroform", no real experience having been gained in the use of other Anaesthetics. In such cases better results will be obtained by keeping to the Anaesthetic, with which the Practitioner is familiar, than by trying strange methods with unfamiliar substances. It is better to have a good working knowledge of Chloroform than to rely on "a nodding acquaintance" with other Anaesthetics and methods. The writer has seen several instances of the wisdom of keeping to familiar methods.

A method of universal application in actual practice has been most nearly attained by Morison of Alexandria, Egypt, with Spinal Analgesia.<sup>(31)</sup> The writer had the opportunity of seeing some of Morison's work in the Summer of 1915, and can testify

to the excellence of the Anaesthetic results obtained. Morison uses Intrathecal Stovaine in 97% of all his cases, the exceptions being Head and Neck Operations, and writes with an experience of no less than 11,000 cases in ten years. The absence of a skilled Anaesthetist was admittedly one of the factors involved but the large figures quoted must include operations of wide variety on every type of Patient, and with the exception of headache, Morison claims an unusual freedom from after effects.

### AGE.

(1). Old Age. The extremes of age are no bar to the administration of an Anaesthetic. The writer's oldest subject was 87, and he meets a fairly large proportion of elderly subjects in the *genito-urinary* practice of Swift Joly. "Age must be reckoned less by years than by healthiness of the Tissues, especially of the Lungs and Vessels"<sup>(32)</sup>. Gwathmey<sup>(33)</sup> expresses the opinion that most elderly patients yield more readily to the combination of Ether and Chloroform than younger subjects and that a mixture of Chloroform and Ether is the Anaesthetic of election in old age is approved by Stuart Ross<sup>(34)</sup> and many others. Subjects of Prostatectomy are usually elderly and a state of Shock is readily produced by Haemorrhage.

In the absence of Bronchial irritation and marked Atheroma, the writer has frequently used the Atropine -  $C_1E_7$  - Ether sequence in elderly subjects. If the Arteries are markedly Atheromatous the  $C_1E_2$  or  $C_1E_3$  Mixture is preferable, which gives a Chloroform type of Anaesthesia. To induce Anaesthesia in Old Age is not, as a rule, difficult and the post-anaesthetic effects, such as

Nausea and vomiting are not of frequent occurrence. In very feeble elderly subjects, without marked Cardiovascular Degeneration, Gas and Oxygen has been used with success.

## (2) INFANTS AND YOUNG CHILDREN.

In prolonged Anaesthesia in Infants and Young Children, the resources of the Anaesthetist may be severely tested. Stuart Ross<sup>(35)</sup> believes that Chloroform is the best drug up to 5 - 6 years with the proviso that it should not be used in acute Septic conditions. It is a usual experience that young children are difficult to Etherize without excessive salivation and Mucorchoea, but the writer's experience has been that C E<sub>17</sub> is well borne after Atropine, and further, that once a state of Surgical Anaesthesia is established, warmed Ether from a Shipway Apparatus, is excellent for fairly short operations. For longer operations usually those of an orthopedic nature, CE Mixture is better throughout.

Langton Hewer<sup>(36)</sup> advises an open Ethyl Chloride - Ethanesal sequence with an ingenious drop feed for the Ethanesal, which has the advantage that the rate of drop is easily controlled. The writer has found that Children take Ethanesal more easily than Ether, though the difficulties of induction are very similar. With Children that are unduly terrified or resistive, the production of rapid unconsciousness becomes almost a necessity, and in such cases the Ethyl Chloride Tube is a comfort to all concerned. Every effort to gain their confidence and unlimited patience should be the golden rule with Children. Those of an age to understand should be told they are going to smell something that will make them feel funny, and send them to sleep, and the writer usually gives them a mask to handle and smell with a few drops of Eau-de-Cologne or Spirit of Orange on the fabric.

In younger Children some struggling and consequent restraint are usually inevitable. The post-operative condition of Children is very largely dependent on the speed and dexterity of the operator. Speed is much more essential than in older subjects. Intra-tracheal Ether and Ethanesal have been used with success for prolonged operations on the neck and intrathoracic regions. Nitrous Oxide alone is unsuitable for young Children owing to the rapid cyanosis without satisfactory Anaesthesia, but the writer has seen excellent results in infants from Gas and Oxygen for Congenital Pyloric Stenosis and has been informed (private communication) that the case mortality has been much reduced by the adoption of this method.

#### SEX.

Females are usually more amenable to Anaesthetics than males and easier subjects for induction. This is probably due to a less highly developed musculature and less frequent indulgence in Alcohol. There is no easier subject than the average female typist and city worker.

### TYPE AND TEMPERAMENT.

The Psychology of the Patient and the mental influence in Anaesthesia has received increasing attention in the past decade, culminating in the elaborate ~~ritual~~ of Crile for "Stealing the Thyroid", in cases of Exophthalmic Goitre. Much American ink has been spilled on this subject, but all American methods would appear to be based on that first propounded by Crile, wherein a series of full-dress rehearsals are gone through, with innocuous injections, until the appointed time of operation, which is not foretold to the patient. This method is not adopted in Thyrotoxic Goitre by James Berry of London. (37/)

It is only of comparatively recent years that facilities for examination of the patient have been afforded to the Anaesthetist. In routine cases it is sufficient to arrive at the place of operation some fifteen to twenty minutes early to make a physical examination of the Heart, Circulation and Lungs, and note the mental attitude; whether excited and emotional, nervous and agitated - phlegmatic or even depressed. The importance of gaining the confidence of Children has already been referred to and a similar method may well be adopted for adults, who have never been anaesthetized before.

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Dudley Buxton has pointed out the difficulty of estimating the danger in any given Anaesthetic, "for whereas we may know the effects of any given amount of Anaesthetic in a normal individual, we do not know what are the effects of the interaction of either Anaesthetics or Analgesics upon diseased Tissues and that further as regards the type of Patient, we do not know how the individual

member of that type will react to the Anaesthetic." "We have to deal with two entities, the conscious and the Anaesthetized; and since the bridging over the passage between perceptive sentience and Anaesthesia - the period of induction - is the acme of the curve of danger in any form of Anaesthesia, we are compelled to study the psychological reaction of the patient towards the Anaesthetic, as well as the physiological reaction of the drug towards the Patient". "It is the danger of Fear-Shock, which becomes most formidable when we have to decide between the use of an Anaesthetic which abolishes consciousness and an Analgesic, whether local or Spinal, which prevents perception of pain, but fails to remove the fear lest pain will come". In support of this, Buxton refers to the Fear-Shock fatalities<sup>of</sup> pre-anaesthetic and early anaesthetic days and of Spinal Analgesia of the present day. In this connection it must be remembered that Patients may come on to the Anaesthetizing Table in a state of considerable repression and emotional "explosions" may follow the abolition of conscious repression by the Anaesthetic. The "explosion" takes place fairly early and should not be confused with the "purple shouting" of the Alcoholic subject.

"No matter what the form of Anaesthesia, it is an extremely helpful auxiliary to have the mind favourably disposed towards it, and the patient properly assured and confident of the successful issue, both of the operation and the Anaesthetic"<sup>(39)</sup>. The persuasive eloquence of the Anaesthetist is likely however, to require material aid in the various Neuroses. In such preliminary medication has its special use. Bromides can be given, where time permits, for two to three days beforehand, and Hypnotics are frequently required, such as, "Dial" (3 grains) or



"Luminal" (3 grains). "Bromural" in 5 - 10 grain doses is also a very useful Hypnotic. Where a potent sedative action is required and Chloroform is not to be used, the Atropine - Scopolamine - Morphine injection can be given an hour before the operation. Idiosyncrasy must not be overlooked and Patients may be found very drowsy and lethargic and with shallow respiration, that makes induction difficult and slow. Once Anaesthesia is established however, relaxation is usually perfect, and very little Anaesthetic is used afterwards.

This injection is often required to produce complete relaxation where Gas and Oxygen is to be used. The adult patient being ready on the table, the writer usually tells him what he may expect to feel, "You may feel your Heart beating very strongly, and you will probably get buzzing and throbbing in the ears; if you feel this, you will know you are 'going-off' alright". Patients frequently ask how they are to breathe and the writer's practice is to ask them to breathe as they like, but through both the mouth and the nose for choice. Blomfield<sup>(40)</sup> lets nervous women hold the mask themselves to induce confidence and avoid the feeling that they are "being rushed".

The Type of the Patient is largely influenced by his personal habits and from an Anaesthetic point of view, it is the bad habits that count, with Chronic Alcoholism well in the forefront. Blomfield<sup>(41)</sup> points out, how the combination of an active open air life and free indulgence in Alcohol, makes difficult subjects, be they Hunting men or Brewers' Draymen. The type of boisterously alcoholic Miner that was fairly common in the wards of the Edinburgh Royal Infirmary in the writer's student days is comparatively rare in the Metropolitan Hospitals. A good deal

of physical force was often expended in keeping such Alcoholics on the table, during induction. Much of this excitation can be alloyed by preliminary medication and induction should be fairly rapid, for which purpose, Gas and Ether is indicated, though if the stage of "purple shouting" be pronounced, a change may be advisable to open methods and the Anaesthetic should not be pushed too rapidly. <sup>(42)</sup> Dudley Buxton claims that, as a rule, Oxygen given with Ether prevents the cyanosis, unless due to severe spasm. Spasm however, is frequent. <sup>(43)</sup> Stuart Ross utters a timely warning against being deceived by the stout, rosy face of a typical Alcoholic, whose apparent robustness disappears after induction has laid bare the broken constitution and poor circulation. It will be obviously unwise to further enfeeble such a condition, by the use of Chloroform. <sup>(44)</sup> Robinson suggests the use of a little Ethyl Chloride where induction is difficult, but the writer prefers to take more time, unless the subject is fairly young, say under forty-five. To produce satisfactory relaxation in a chronic Alcoholic may be absolutely beyond the power of inhalation Anaesthetics, when given only to the limits of safety, though much may be done by preliminary narcotization where alcoholism is a known or suspected factor. <sup>(45)</sup> Blomfield is apparently of opinion that the Surgeon's convenience should be the main consideration of the Anaesthetist. The writer is of opinion, that if such be true, it were better to use combined Local or Spinal and General Anaesthesia, than attempt to force the Anaesthetic on a subject that is, in all probability already suffering considerable Oxygen deprivation. In Abdominal cases the Thighs may be elevated and the Head

raised a little, on the usual type of operating table, without causing interference to the Surgeon.

Induction may be difficult in heavy Smokers, with an irritable pharynx, causing a good deal of explosive coughing even on the exhibition of a fairly weak vapour. It is always wise not to smoke on the day of operation. The capacity and desire to smoke under all conditions was well illustrated in the late War. The writer has seen shattered men in whom the sands of life were obviously fast running out, trying to smoke the inevitable Cigarette and has recently seen a barrister, who was anaesthetized at 10a.m. for Prostatectomy smoking a Cigar after dinner time the same evening. Young men frequently ask for a Cigarette within a few hours of the operation.

#### EPILEPSY AND ANAESTHESIA.

The writer has observed a typical Epileptic Fit, early in the second stage of Anaesthesia in a male epileptic patient, who was being anaesthetized for Laparotomy. The Anaesthetic was withdrawn for two or three minutes, and was thereafter uneventful. The Patient made an excellent recovery.

#### INSANITY AND ANAESTHESIA.

Apart from Insanity with possible resistiveness, there are no special indications for the choice of the Anaesthetic. Attacks of acute mania have been described as likely to occur in those liable to periodic attacks. The writer has anaesthetized a relatively large number of certified lunatics in the past sixteen years, but has no experience of such attacks. He has,

however, on two occasions failed completely to induce any Anaesthesia whatever with Nitrous Oxide. Both cases were for Extraction of Teeth.

MENSTRUATION & LACTATION have no influence on the choice of the Anaesthetic. The writer has never observed the emotional instability during Menstruation that is mentioned as a possible occurrence during induction in most of the published works on Anaesthetics. Lactation is not adversely influenced.

PREGNANCY, "per se", is no bar to urgent Surgical procedures, and many Anaesthetics have been administered in all stages of Pregnancy without evicting the foetus. Premature labour has been reported when interference was near "Term". Open methods are essential throughout to avoid every possible element of Asphyxia.

## CHOICE OF ANAESTHETIC.

### PHYSICAL CONDITION OF PATIENT.

#### General Physique and Standard of Health.

The well developed and muscular are usually difficult subjects especially if heavily built. The easiest subjects are the rather frail looking people, the Office Worker and the Typist. Hewitt<sup>(46)</sup> points out that fairly muscular boys, with some nasal obstruction and a nervous system, that is sensitive, are often difficult subjects for laparotomy and that Nitrous Oxide and Oxygen is the best Anaesthetic for such cases, as Ether often increases the respiratory difficulty. If this is not available, a weak C E Mixture is indicated. The writer has found a C E Mixture is usually  
1 7  
satisfactory for induction, though to obtain adequate relaxation may be difficult. Provided the respiration is smooth and adequate and induction has been uneventful, he has found a semiclosed method adequate. The C E is changed for C E or plain Ether  
1 7                      1 32  
for a brief period - if the transition is smooth the mask is gradually drenched with Ether, and a large towel is used as a cone over the mask and round the face and the Patient is rapidly saturated with a concentrated but warm vapour. The resulting Anaesthesia is usually excellent and is not of the "snorting" Ether type. Using plain Ether the method is described by Rood,<sup>(47)</sup> as particularly applicable for the deep Anaesthesia required by many Surgeons for the dissection operation on Tonsils. For those who doubt the possibilities of Ether Anaesthesia in Throat work a few hours will be well spent in watching Rood's work and his methods.

ANAEMIA, is fairly common in young women with indoor occupations and they take Anaesthetics easily provided open methods are used. With Nitrous Oxide alone they may behave like young Children, and become

rapidly cyanosed and stertorous, with a brief and poor Anaesthesia. With a Hewitt's or Clarke's Apparatus, such as many dental Surgeons possess, this cyanosis can be avoided and the Anaesthesia much prolonged by the admixture of Oxygen.

OBESITY. Most Anaesthetists have vivid memories of the bull-necked man, who has made their fingers ache owing to the constant pressure required to keep his jaw well forward and his respiration free. As far as the writer is aware, Hewitt was the first to point out that in Phlethoric subjects the tongue may actually swell and increase respiratory obstruction, which may thus be postural or mechanical. In such cases the use of a mechanical airway, such as that associated with Hewitt's name is of the greatest value. Closed methods should not be attempted in such cases owing to the probability of further respiratory embarrassment. Posture during induction may decide the issue between normal and difficult cases, such patients should be allowed to lie in the position of maximum comfort and respiratory ease, and the head of the table should be raised until such is obtained. Anaesthesia in the obese is most satisfactorily obtained with some CE Mixture. (48) Gwathmey states that "the healthy obese patient seems to be immune from any poisonous after effects of Chloroform". It is not obvious why a Cardio-toxic Anaesthetic should be chosen in a subject whose heart is probably overloaded with fat. The Trendelenburg position may give rise to considerable cyanosis in the Obese.

THE ORDINARY INDIVIDUAL.

The ordinary individual with no marked peculiarities of Physique or Temperament, fortunately forms the largest percentage of Anaesthetic work in Hospital, and private practice. What then is to be the routine method adopted? For fairly short operations where complete relaxation is not essential Gas and Oxygen is unquestionably the best choice. For longer operations this method is by no means free of danger, and considerable experience and judgment is necessary to maintain an even level of Anaesthesia without undue cyanosis. If difficulties are met with it is better to place increased reliance on the Ether Bottle in the circuit, than to try and maintain a pure but difficult Gas and Oxygen Anaesthesia. If Gas and Oxygen is not available Gas and Ether is rapid and complete relaxation can usually be obtained. <sup>491</sup> Blomfield has pointed out how increased reliance can be placed on Nitrous Oxide to continue the Anaesthetic state in short operations, thus avoiding many of the unpleasant after effects of ordinary Gas and Ether. Gas and Ether is excellent for many short operations where a fairly deep Anaesthesia is required, such as operations for Haemorrhoids and Fistula in Ano. It is also useful for putting up Fractures and the reduction of Dislocations in which Chloroform has gained such an evil reputation. It can be used for rapid induction as a preliminary to open Ether, CE Mixture or Chloroform. Experience is essential to get the best results, especially in the recognition of the moment when to change from Gas to Ether.

PHYSICAL CONDITION OF PATIENT.

If a Gas and Ether Apparatus is not available the CE - Ether sequence is one of the most reliable and generally applicable methods for all



operations. If rapid induction is required, Ethyl Chloride can be sprayed on the mask. The CE Mixture can be used in various "strengths". C E to C E is most generally useful. With Morphine  $\frac{1}{4}$  1 7 Atropine ( $\frac{1}{6} \times \frac{1}{100}$ ) an hour before hand, either of the above mixtures with open Ethyl Chloride is an excellent routine Anaesthetic, and with slight modifications to suit the individual, the writer has employed this method with confidence. A very similar method is enthusiastically supported by Barton. (50) Mixtures of Chloroform and Ether have been used in all proportions from the old ACE Mixture to the C E, which can be used according to Silk, (51) under the same conditions as pure Ether, i.e. with pure perhalation methods and many layers of gauze. The Chloroform effect is trivial, yet sufficient to take off some of the bite of Ether. Physiologists object to CE Mixtures on the ground, that the effects of the component Anaesthetic substances are additive, i.e. that the resulting Anaesthesia is merely a weak Chloroform and a weak Ether Anaesthetic combined. The type of Anaesthesia obtained would certainly bear this out.

The Anaesthesia is usually quiet and not of the boisterous Ether type. The clinical fact, however, remains that weak mixtures are in many ways ideal; after effects are usually trivial and the patients recover quickly. Acidosis or "Ketosis" with serious vomiting and collapse is not seen, neither is there the Pulmonary irritation of Ether. No complicated Apparatus is required. Adequate relaxation can usually be obtained for Abdominal Operations.

As opposed to the muscular, the obese, and the ordinary individual, it should be remembered that those who are seriously ill are generally easy to Anaesthetize. and frequently welcome the Anaesthetic if pain is a predominant feature of their suffering.

## CHOICE OF ANAESTHETIC.

### PHYSICAL CONDITION OF THE PATIENT.

Septic conditions of the mouth, especially the teeth have been accorded considerable importance in the production of post-anaesthetic Bronchitis and Bronchopneumonia. Great stress is laid on the pre-anaesthetic Hygiene of the mouth by American writers, though the benefits of a mouth wash where the Septic Focus is deep in the alveolar process, would appear to be doubtful. If oral Hygiene is of such supreme importance, it is extraordinary that at least fifty per cent of all Hospital patients do not get Pulmonary complications after operation.

### RESPIRATORY DISEASES.

Acute "colds" and acute catarrhal conditions in the Trachea Bronchi and Bronchioles and even the Pleura are immediate contra-indications to the use of any closed methods and, speaking generally, to the use of Ether. Cases of Chronic Bronchitis, however, will frequently take a Morphine Atropine  $C_1E_3$  sequence quite well. If coughing or Mucorrhoea occur it is better to make an early change to Chloroform and the advent of duskiness or Dyspnoca after taking all possible precautions to preserve a free airway, is best met by Chloroform and Oxygen from a Shipway Apparatus. Spinal Analgesia has been suggested in such cases and McGavin<sup>(52)</sup> gives the "Pulmonary Diathesis" as one of the indications for the intrathecal route. Wills<sup>(53)</sup> of Philadelphia supports the opinion with the proviso that it is not used in :-

1. Acute Febrile Tuberculosis.
2. Large Pulmonary Effusions.
3. Large Intra-thoracic Growths.

To obtain a good Anaesthesia with relaxation especially of the upper Abdomen, in a Chronic Bronchitic subject, with a somewhat rigid emphysematous Chest may be quite beyond the power of Inhalation Anaesthetics.

(54) Stuart Ross advises the routine use of Morphine-Atropine as an adjuvant to the prevention of post-anaesthetic pneumonia, but the Morphine may well be omitted if the operation is likely to be prolonged and Chloroform has been selected.

In mild Respiratory Catarrh the Atropine-Morphine-Hyoscine-Gas and Oxygen sequence is commended by many except in cases of active or recently healed Pulmonary Tuberculosis. (55)

(56) Rood states that respiratory obstruction in the widest sense, within or without any part of the Respiratory System is an indication for Chloroform, while Hews (57) states that Ethanesal has been given to a large number of patients, who were suffering from acute or Chronic Bronchitis, without any appreciable aggravation of symptoms. In the opinion of the writer, Hews has been singularly fortunate if Children formed any appreciable percentage of the cases.

That Morphine-Atropine-Ether, specially with a warmed vapour and combined with Oxygen, is not always contra-indicated in respiratory diseases is proved by the large and increasing number of cases, in which it has been successfully used.

The warmed oxygenated vapour frequently causes no apparent irritation, though the writer hardly goes so far as Torrance Thomson, (58) who expressed the opinion, that in Chest complications skilful administration was more important, than choice of Anaesthetic. Shipway is quoted by Dudley Buxton, as stating

that, Intra-tracheal Ether is well borne in the case of Bronchitis. Pulmonary Sigus at the right base, have been frequently noted before and after operations of the Gall Bladder, and quite frequently attributed to the Anaesthetic. Wilkie<sup>(59)</sup> has pointed out the clinical signifance and Anaesthetic insignifance of the signs and states that, the Pulmonary condition will be effectively treated by dealing surgically with the primary focus of disease.

Mrs. Dickinson Berry<sup>(60)</sup> believes that Ether Bronchitis is a myth, - an opinion that is gaining ground amongst Anaesthetists, where preliminary narrotization and a careful " open " Etherization, is the method. Much depends on the length and depth of Anaesthesia required. Chloroform, with or without Oxygen, is still the Anaesthetic of election for Tracheotomy in Diptheria, for the removal of Foreign Bodies in the Air Passages and for severe Cellulitis of Neck (Angina Ludovici).

EMPHYEMA. The average Anaesthetist hardly looks forward to such cases. In acute Emphyema, local Anaesthesia is the Anaesthetic of election. With inhalation Anaesthesia the position of the Patient is all-important. He should lie partly propped up, with the affected side over the edge of the table. If turned on to the sound side Cyanosis is inevitable, and may be alarming. Chloroform and Oxygen is the best Anaesthetic, though warmed Mixtures and Oxygen from a Shipway Apparatus have been frequently used with success. The Ether can be cut off if causing distress. Gas and Oxygen is recommended by Blomfield.<sup>(61)</sup> In chronic Emphyema the Anaesthetic conditions are more easy, though one is dealing with a constitution

impaired by chronic suppuration.

In Pulmonary Tuberculosis, Ether has been credited with causing active recrudescence of a quiescent focus of disease, but the Morphine-Atropine-Open Ether sequence, will give a quiet Anaesthesia in the absence of inter-current Catarrh, for which Chloroform and Oxygen should be used. The respiratory complications after Anaesthetics, especially Ether, during the late War, cannot be taken as any criterion of results in civil life and of the pitch of excellence obtained with open Ether. Soldiers, whilst still unconscious, were frequently carried quite long distances in the open, and then placed in draughty huts or tents.

#### Renal Conditions and Abnormal Constituents of the Urine.

Routine examination of the Urine is always advisable. A small box of Endolytic Tubes, with qualitative Tests for Albumen, Sugar, Acetone and Diacetic Acid takes up but little space in the Anaesthetic Bag. Acetone is of frequent occurrence in the Urine of Children. It is chiefly of importance in Chloroform Anaesthesia and septic conditions. <sup>(62)</sup> Hewer states that Ethanesal has no ill effects in Children passing large quantities of Acetone. The older objections to Ether in Renal disease have not been upheld by increased experience, and while Gas and Oxygen will be the Anaesthetic of election as causing least damage to the Renal Parenchyma, open Ether is commonly used in Major Surgery and Anaesthesia should be fairly deep while the kidney itself is being handled.

<sup>(63)</sup> Underhill and Rapsinow have pointed out that during Anaesthesia the Chloride excretion is unaffected, and that the apparent

increase is due to preparation (Starvation) before operation. They also found that the symptoms of Acidosis or so called delayed Chloroform poisoning, were not due to the liberation of Hydrochloric Acid, and that alkali administration has no effect in inhibiting delayed Chloroform poisoning. The objection to prolonged starvation, specially in Children has been sustained clinically and the mortality of added sepsis and Chloroform has already been considered.

DIABETICS are notoriously bad subjects for Chloroform and Spinal Analgesia or Gas and Oxygen should always be used. Hewer, of course, advises Ethanesal. The presence of considerable amounts of Albumen or a Tuberculous ~~Pyo~~-Nephrosis should be dealt with similarly to Diabetes. Bile in the Urine in an overworked Liver is a contra-indication for Chloroform. The Urea estimations of Blood and Urine prior to Prostatectomy do not fortunately come within the province of the Anaesthetist. The chief interest in Tuberculous Disease of the Bladder lies in the preliminary distension and washing out of the Bladder. It is well to recognise at once, that violent reflexes are probable and be prepared for them.

AN AMERICAN OPINION.

<sup>(64)</sup> Thomas of New York, writing with that directness and "pepp" beloved of Sinclair Lewis and other American Novelists, is of opinion that a well organised Hades has a special corner for the routine administrators of Ether, simply because it is "the safest general Anaesthetic in the hands of the average Anaesthetist". Thomas further states that Nitrous Oxide and



Oxygen has been used 35,000 times without fatality, - truly amazing figures, but apparently of unrecorded origin. Thomas prefers Spinal Analgesia for Prostatectomy and Nephrectomy operations and states that the usual fall of Blood Pressure can be anticipated by immediately lowering the Patient and giving an injection of Pituitrin. <sup>(65)</sup> Hewer advises the same injection simultaneously with the Spinal in cases of Shock. It is now generally accepted that the time of fixation of a Spinal injection has been over-estimated, and that there is no need to keep the Head elevated for so long to avoid upward spread of the paralytic effect. ~~The~~ Use of Strychnine combined with the Spinal Analgesic is now discredited, but other stimulants have been advocated - such as, Caffeine.

#### CARDIO - VASCULAR ABNORMALITIES.

Cases of well compensated Valvular Disease present little difficulty as a rule, and do not modify the choice of the Anaesthetic. The writer has, with open methods, Anaesthetized cases of Aortic Regurgitation and Mitral Stenosis, without any special difficulty. With any failure of compensation, Oedema or Orthopnoea the greatest care and patience should be exercised. Posture becomes of increased importance and for induction, the Patient should be propped up to a comfortable height. Open CE should be given and every effort made to avoid undue excitement or increase in the asphyxial element.

After induction Anaesthesia may be maintained with C F <sup>1 32</sup>.

For desperate cases Oxygen may be blown through the Ether in a Shipway apparatus. Difficulty in diagnosis of the grave



Myocardial degenerations such as fatty degeneration or cases of unsuspected pericarditis has led to several Anaesthetic fatalities. A weak myocardium should be suspected where the impulse is feeble and the sounds distant; and after Fevers, especially Diphtheria, Influenza and Malaria. Where possible the patient's exercise tolerance may be tested or his capacity for holding the breath.

Marked Atheroma with high Blood Pressure and cases of Aneurysm should be treated with the same caution as severe Cardiac Disease. Nitrous Oxide and Nitrous Oxide and Oxygen are contra-indicated and every effort made to avoid excitation and a further rise in Blood pressure. The importance of this latter has led Blomfield and Dudley Buxton to use Gas and ~~Ether~~ for induction, but beyond rapidity the method has little to recommend it for such cases. The writer prefers a few breaths of a Mixture, than open Ethyl Chloride changing into C E Mixture somewhat after the method described by Barton.<sup>(66)</sup> 17 Ether even in Mixture cannot be given to everybody.<sup>(67)</sup> Phillips mentions two cases of patent ductus arteriosus Anaesthetized with Chloroform and Oxygen, where the addition of a small quantity of Ether caused Cyanosis and respiratory distress.

#### DISEASES OF LIVER.

In Cirrhosis and conditions of Jaundice, especially malignant Jaundice, Chloroform should be eschewed on account of its deleterious effect on the Liver Cells. In operations on the Gall Bladder, the Anaesthesia should be fairly deep. It is frequently difficult to obtain adequate relaxation.

## THE ACUTE ABDOMEN.

Most varieties and difficulties of Anaesthetization can be met with under this comprehensive heading, including, as it does, such a large proportion of the emergency operations of practice, viz., Acute and Urgent conditions of the Appendix, Stomach and Gall Bladder. The large and small intestines with Hernia Twists, obstructive growths and acute Diverticulitis, the Female Appendages, etc.

Many conditions will arise over which the Anaesthetist has no control, the most frequent being cases of Acute Sepsis and Shock from inflammation and rupture of a Viscus. The importance of a fulminating type of Sepsis is seen in those acute inflammatory cases, in which there is no compensatory Leucocytosis. It is in severe Abdominal Conditions that the work in a Casualty Clearing Station in the late War is most nearly reproduced. While many of the Anaesthetics may be said to be "easy" in so far as it is frequently easy to produce a state of unconsciousness, the well-being after operation, and the chances of recovery are in no small measure due to the skill and judgment of the Anaesthetist. It may be stated at once, that there is no golden rule, - each case must be judged on its merits as to choice of Anaesthetic and the necessity for intravenous infusion for resuscitation purposes. The experience of the late War has abundantly proved that Nitrous Oxide & Oxygen is least likely to further increase a state of established Shock, but the writer fully agrees with Hulme-Henderson<sup>(68)</sup>, that it is unwise to spoil the case for Nitrous Oxide & Oxygen by over-estimating its claims or under-estimating its possible dangers. The writer always advises the insertion of an artificial airway as soon as the Patient is "under".

The Anaesthesia may be of such a light and evanescent nature, that to remove the face piece to do so in the course of an operation may only further increase the difficulties of both Surgeon and Anaesthetist. The choice of Anaesthetic in desperate Abdominal conditions is always difficult. Spinal Analgesia has been frequently used, but with a mortality that is, at least, as large, as that of inhalation methods. The Spinal method presents no advantage over Nitrous Oxide & Oxygen with local infiltration. Oxygen combined with Ether & Oxygen with Chloroform have both been used with success, and it must be remembered that the vomiting of Acute Obstruction is not controlled by the use of Spinal Analgesics. The intravenous infusion of Ether in Saline Solution was hailed, some eleven or twelve years ago as the ideal method for exhausting operations in shocked patients. The writer received instruction in the method from its supporters at University College Hospital. Its present use (along with the ~~use~~ of Hedonal infusion) would appear to be solely confined to Text Books. Whatever method is used in bad cases, it is generally admitted that the Anaesthesia should be as light as possible and only just sufficient to permit of adequate surgical interference. Once the abdomen is opened, minimal quantities of Anaesthetic usually suffice until the peritoneal toilet and stitching up of the muscles. No less an authority than Shipway has recently expressed the opinion that there is a tendency to administer all Anaesthetics to an unnecessary depth. With this opinion, the writer, "pace Crile" agrees. We do not hear of cerebral bombardment by sensory stimuli in severe and acute

abdominal conditions and the Anaesthetist very wisely strives to keep the Patient lightly "under". The difficulty of obtaining complete relaxation has already been mentioned. Respiratory reflexes may be frequent from traction on the Viscera but are not "per se", any indication to deepen the Anaesthesia. A word of warning is necessary against that moment, when the Surgeon<sup>may want</sup> to "have a look round". It may be disconcerting if the Surgeon suddenly, inserts the whole hand into the Abdomen and feels for the Gall Bladder or pulls up the Uterus, etc. Mutual recrimination can be avoided by watching and asking for due warning.

In prolonged abdominal operations, lasting over an hour, Dudley Buxton<sup>(69)</sup> has pointed out the advantage of changing from Ether to Chloroform or the Alcohol Chloroform Mixture to avoid the collapse due to over-stimulation with Ether. This, however, is seldom seen with the Atropine-open-Ether sequence, though it was fairly frequent with the "old" Gas and Ether from a Clover's Inhaler.

#### PARTURITION & OBSTETRIC CONDITIONS.

Parturient women take Anaesthetics well and usually welcome the appearance of a mask. The older established practitioner usually uses Chloroform in such cases, and the dangers of induction and light Anaesthesia are apparently absent, though the writer knows of one fatal case and at least, two "frights", in the practice of a very experienced and skilful practitioner. The writer's practice was to use C E or C E in such cases and especially with the latter, found that an Analgesic state could be maintained without such cessation of pain as was produced by Chloroform. Blomfield<sup>(70)</sup> states that "with proper discretion,

Chloroform delays very little, if at all, the duration of a normal labour". His experience is not general. The use of Scopolamine and Morphine is for the Obstetrician, and where these Narcotics have been used, the writer has been frequently informed of the excellent relaxation obtained, even with a light degree of Anaesthesia.

<sup>(71)</sup>  
Martin advises the repeated injection of 0.5 CC of Pituitary extract - in all up to 3.0 CC - to stimulate the pains, while a light Chloroform Analgesia is maintained from a Junker Inhaler. <sup>(72)</sup>  
Oldham recommends Sacral Analgesia and states that it facilitates delivery, but no mention is made of that uncertainty of action, which has been experienced in this country by Lockhart Mummery. Quite large amounts of the injected fluid may be required.

#### Conditions of Central Nervous System.

In many Cerebral or Cerebellar cases no anaesthetic will be required if the Patient is comatose, and if semi-comatose, a few breaths to resect the Scalp may be all that is required. In decompression operations a minimal amount of "open" Anaesthetic should be used, preferably Chloroform and Oxygen, from a Shipway Apparatus. Respiration may fail at any moment, though it usually improves at once, when the intracranial pressure is relieved. Very little Anaesthetic is required after this. Intra-Tracheal Ether is suggested by Blomfield for operations on the Occiput, where flexion of the Neck is demanded by the Surgical procedure, though the lateral posture and a suitable head-rest are usually all that is necessary. A similar difficulty as well as the

probability of Shock, is met with Laminectomy for Spinal Conditions. Posture can again be dealt with by Intra-Tracheal Ether, whilst Shock must be treated on general lines.

#### THE FEBRILE STATE.

The Febrile state from the Anaesthetic and Surgical point of view, is usually merely a general manifestation of the local focus of infection and the Cardiac Musculature shows in the general toxaemia.

The writer has not observed the difficulties of induction encountered by Blomfield.<sup>(73)</sup> The occurrence of Acidosis or Ketosis or Post-Anaesthetic Toxaemia, specially in Children has already been mentioned.

#### GOITRE-HYPER-THYROIDISM & EXOPHTHALMIC GOITRE.

The latter condition is of peculiar interest to the writer, in so far that the condition caused a recent hiatus of nine months in his professional career.

The Cardiac irritability of Thyrotoxic Goitre has led to a multiplicity of efforts to circumvent Anaesthetic and Surgical disaster. Crile's earlier method of "stealing the Thyroid" has been modified in his later practice. Patients are not deceived as to the time of operation but are not told, unless they ask. If their condition becomes unsatisfactory as the result of this information, operation is deferred. Crile and Lower<sup>(74)</sup> make the very interesting observation that a collapsed Trachea can be dilated at will by administering Oxygen under pressure. Mrs. Dickinson Berry has since 1912 abandoned all



other methods in favour of a very light Atropine-Open Ether Anaesthesia, specially light at the moment of dislocation of the tumour. Mrs. Dickinson Berry uses one layer of lint or gauze (4 ply) or a double layer of stockinette.

The Anaesthesia is so light that occasional phonation or movement may occur. The extremely light depth of Anaesthesia and the results obtained by James Berry are a most striking reply to those, who maintain that full Surgical Anaesthesia is necessary as a preventive of Shock.

Berry advises that subjects with Cardiac trouble from either long standing Dyspnoea or True Graves' disease should be first examined with X Rays and Electro-Cardiograms.

(75)  
Lathrop has used Rectal Oil Ether in 166 cases of Hyperthyroidism or Exophthalmic Goitre and has found the post-operative condition to be better than with Inhalation Anaesthesia.

(76)  
Dunhill knows of two deaths from 75% Rectal Oil Ether from respiratory failure after operation, which he did not think would have died otherwise. He states that Patients have told him that they prefer open inhalation methods. Dunhill prefers local Anaesthesia, or open Ether, without Narcotics, in these patients, who have not the necessary self-control.

(77)  
Sir Harold Stiles is stated to have a preference for Intra-Tracheal Ether.

The Intra-Tracheal route may be the anaesthetic of election in cases uncomplicated by respiratory obstruction, and has the advantage that pulling on the trachea is less likely to interfere with an even Anaesthesia, though in obstructed cases the depth of induction required may be a bar to the use of this method.



(78)  
 Dickinson advises a routine with full dress rehearsals similar to Grile's earlier methods, save that Colonic Oil Ether is used. Dudley Buxton (79) has commonly used Chloroform and Oxygen and found the method satisfactory. While Chloroform may be safe in such experienced hands, it should be studiously avoided by the great majority. The consensus of British opinion is in favour of a light Atropine-Ether Narcosis save amongst those, who still practise Local Anaesthesia. It should not be forgotten that, whatever the nature of the operation, Oil-Ether per rectum can, if necessary, be reinforced by Inhalation methods. Any mention of the Surgery of the Thyroid Gland would be incomplete without reference to Kocher of Berne - a protagonist of local Anaesthesia. Blomfield (80) naively states that it is permissible to doubt whether Kocher had the best forms of general Anaesthesia at his disposal.

Simple Adenomata of the Thyroid present no difficulties apart from those connected with respiratory obstruction, which may be increased by the Anaesthetic. James Berry advises that no Anaesthetic on the Thyroid Gland should be commenced until the Surgeon has washed up and is ready to perform Tracheotomy at a moment's notice.

## SHOCK.

SHOCK is the physical expression of exhaustion from Trauma, whether "Psychic, Traumatic Toxic or Thermal" ( Crile).

According to the teaching of Crile, although no pain is felt in operations under inhalation Anaesthesia, the nerve impulses excited by a Surgical operation still reach the Brain - the operation is graphically described by Stuart Ross<sup>(31)</sup> as a state of constant cerebral bombardment by sensory stimuli. Considerable doubt has been thrown on Crile's statement. If this be the whole truth, why is it that Nitrous Oxide and Oxygen with a light depth of Anaesthesia is the least likely Anaesthetic to produce or increase Shock. The production of Shock is dependent on many factors, such as, Haemorrhage and Wounds - Deficient Oxygenation, Acidosis or Acidaemia. Shock is also partly due to chemical changes and to the production of some Histamine-like substance in injured Tissues. Histamine is a substance which produces the symptoms and physical changes of Shock, if injected into the body. Crushing injuries are more likely to produce Shock, and it has been found experimentally that Crushing the Thigh muscles of Cats produced profound Shock which, however, could be prevented by clamping the vessels and thus preventing the chemical product of Shock from entering the general Circulation. The conditions found in Shock are :- Lowered Blood Pressure and Temperature - Small Pulse - Contraction of the Arterioles, with partial or complete stasis in the Capillaries - a diminution in the Blood and especially the Plasma Volume with resulting increase of Viscosity - Shallow respiration, with accompanying deficiency of Oxygenation - Degenerat-

ive changes in the cells of the Cortex Cerebri have also been described by Crile. The injection of Strychnine, Adrenalin and Pituitrin will thus obviously fail to ameliorate such a condition of peripheral vaso-constriction. In either Acidosis Shock or Wound Shock the restoration of the volume of Blood in effective Circulation is the only effective Treatment, and whilst the Transfusion of Blood direct is the method of election, the intravenous Infusion of Bayliss' 6% Gum in normal Saline has the advantage of being easily prepared and constantly available. This gained the Acidosis will disappear naturally. An adequate Oxygen supply to the Tissue cannot be provided by the Inhalation of Oxygen.<sup>(82)</sup>

Oxygen Inhalation will not cure Acidosis Shock for the Oxygen Tension of the Inspired Air can be reduced to less than half without seriously impairing the Tissue Oxidation.

In certain cases of severe Wound Shock the Blood Vessels are incapable of retaining an adequate amount of fluid in the Circulation.<sup>(83)</sup>

Once a state of Shock is established it is accentuated by the Anaesthetic - more profoundly by Chloroform and less profoundly by Nitrous Oxide and Oxygen. The question of Shock and Anaesthesia can never be dissociated in the mind of the Anaesthetist for the clinical picture of too prolonged Anaesthesia or overdose is clinically identical with Shock. The clinical picture of a prolonged profound Chloroform Narcosis is that of Shock. The European War has abundantly proved that once a state of Shock is established it is difficult to treat by any single remedial measure, that the ideals to be aimed at

were firstly, rest and quietude, aided by Morphine injections, the restoration of the Circulation by warm drinks and if necessary Intravenous Infusion or Transfusion, prior to attempting any operative procedure. These conclusions were first forcibly borne on the writer in the Summer of 1915, when on one of H.M. Hospital Ships, evacuating Sick and Wounded from Gallipoli. On the writer's first "voyage", conservative methods were adopted. Hot Bovril and Morphine was the routine adopted, partly from conviction, but principally because nothing else was available. One or two decompression operations were done by an old friend and fellow student - H. S. Davidson of Edinburgh. Deaths were few and the wounded arrived in Egypt some fifty to sixty hours later in a much improved condition. On the second "voyage", similar methods were advised and adopted by Col. Mayo Robson, for whose unfailing courtesy and advice in unfamiliar tasks, the writer will be ever grateful. On a subsequent voyage from Cape Helles, with another Consulting Surgeon many operations were undertaken within a few hours of the arrival aboard of the wounded. Many cases were still in a state of profound Wound Shock, increased by being tossed about on the barge. The results, as evidenced by the Burials at Sea, left a good deal to be desired and incidentally a very lasting impression on the writer.

## STATUS LYMPHATICUS.

Status Lymphaticus is a clinical entity usually diagnosed on the Post-Mortem Table. It is characterized by a Splenic and General Lymphoid Hyperplasia with an enlarged or persistent Thymus Gland. Children suffering from this condition are said to be unduly nervous and may be subject to cyclical vomiting. Some Text Books advise that in suspected cases Skiagrams should be taken. The writer has made enquiry of several radiographers, who are all somewhat reticent and evasive on this subject. The advantage of Skiagraphy would appear to be more theoretical than practical. Sir B. Spilsbury has personally investigated 174 Anaesthetic Fatalities from 1913 - 1922, in which there were 26 cases of Status Lymphaticus. Status Lymphaticus is usually a condition of Childhood and tends to disappear with advancing years. The writer knows of no method of diagnosis, but has learnt to respect as bad subjects, the reddish or "sandy" haired Child, with a clear translucent-looking and freckled skin. Such Children are usually nervous, frequently have "glands", with enlarged Tonsils and Adenoids and Nasal Obstruction.

## PRELIMINARY INJECTION OF ALKALOIDS.

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The Preliminary injection of Atropine is a sound routine, whatever Anaesthetic method or substance is used. The Laboratory conclusions of Sir E. Schaefer are borne out by clinical experience, although Goodman Levy objects to Atropine on the ground of safety, as he believes that "if Vagal tone be abolished, the Ventricles are more ready to pass into an irregular Tachycardia and subsequently to fibrillate." The use of Atropine-Morphine or Atropine - Omnopon or Atropine - Heroin was, until recently, general before Etherization, and has helped to revolutionize previous ideas of the capacity and type of Anaesthesia produced by open Ether. Atropine alone is now more frequently used, unless a sedative is also required. The use of a respiratory depressant, such as Morphine. prior to Chloroform, is not generally advisable. It is an interesting clinical fact that Atropine in doses of  $\frac{1}{100}$  grain very seldom has any effect on the pupil, whilst a small dose of Morphine, such as  $\frac{1}{4}$  grain quite frequently, causes contraction, which is not altered by a full degree of Surgical Anaesthesia. The addition of Hyoscine is usual only in Parturition, or as a preliminary to Nitrous Oxide and Oxygen, where relaxation is necessary for the Surgical procedure. Narcotic Injections should be given a full hour before the time of operation, and the Anaesthetist should be prepared for shallow respiration, where a Narcotic effect has been obtained.

CONCLUSIONS.

Ether and weak Mixtures (C E , C E ) are still the most  
 1 15 1 32  
 useful routine Anaesthetics. For enfeebled and Shocked subjects  
 Gas and Oxygen or Warmed Oxygen - Ether are always indicated.  
 Chloroform should never be used unless respiratory obstruction  
 demands it. Further experience has only fortified the opinions  
 (34)  
 expressed by the writer in 1914, on the dangers of Chloroform,  
 whilst the advocated use of open Ether has of necessity been  
 modified by the increasing utility of Gas and Oxygen.

The Anaesthetic should not be selected until the Patient has been  
 seen and examined, and the probable duration and difficulties of  
 the operation taken into consideration. During the operation,  
 the intelligent anticipation of events - or what the writer has  
 described to pupils as the "Anaesthetic sense", is vastly more  
 useful than retarded cerebration and restoratives.

Ethyl Chloride is only safe as a single dose Anaesthetic or as  
 a preliminary to open Etherization. It will not do the work  
 of Ether or Chloroform.

The choice of Spinal Anaesthesia is best left to the wish of the  
 Surgeon. Infiltration Anaesthesia should generally be left  
 in the hands of the Surgeon.

The Anaesthetic state should never be induced without adequate  
 realization that a human life may depend on the skill and care  
 of the administrator.



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